Program: SPR-0010(36) FFY99	Part: II Research and Development

Project Title: Gyratory Compactor to Measure Mechanical Stability of Asphalt Mixes   **Project ID:** 0092-01-02

Administrative Contact: Nina McLawhorn   **Sponsor:**

WisDOT Technical Contact: Error! Bookmark not defined.   **Approved Starting Date:** Nov 1, 2000

Approved by COR/Steering Committee: $55,337.00   **Approved Ending Date:** Dec 31, 2003

Project Investigator (agency & contact): Hussain Bahia: UW-Madison

Description: This study will be conducted over 12 months, and will be completed in five (5) phases.

Task 1: Literature and Equipment Design Review

Task 2: Laboratory Study of Field Produced Samples

Task 3: Establish a Mixture Design Criteria

Task 4: Preparing Plans for Future Field Study

Task 5: Prepare and Submit Final Report

Background:

The Superpave volumetric mixture design procedure does not include a measure of mechanical stability of asphalt mixtures. Although there are few efforts at the national level to develop a separate test for measuring a performance property, it is not known whether these efforts will be successful. It is also not know whether such test will be practical enough to be used as a quality control test by the contractors in the field.

Recent research work at the University of Wisconsin-Madison (funded by FHWA in 1998-99) has resulted in developing a simple accessory that can be used to measure internal friction of asphalt mixtures during the compaction process. The simple device has been used to test several mixtures produced in the field by contractors in Wisconsin. The results are very encouraging and show a high potential for success. This research effort has also indicated that the Superpave Gyratory Compactor could be modified to provide the means for measuring the mechanical stiffness and strength at conditions that simulate field conditions under traffic.

There is a need to continue this effort and explore all possible uses of the gyratory compactor to measure frictional resistance of mixtures during compaction and also mechanical stability under traffic conditions. The Wisconsin DOT and the Industry in Wisconsin can benefit of a simple device that is part of the gyratory compactor that can measure performance-related properties of mixtures. Such a device could be used to enhance the mixture design process to include a mechanical stability measure.

Total Study Budget	Current FFY Budget	Expenditures for Current Quarter	Total Expenditures to Date	Percent Complete
$55,337.00	**$13,834.25**	$0.00	**$45,308.52**	**98 (%)**

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Progress This Quarter:

(Includes project committee mtgs, work plan status, contract status, significant progress, etc.)

This quarter, the research team developed a criterion to determine the flow number for the mixtures. This was necessary because the data collected for Wisconsin samples indicated that the procedure recommended by the NCHRP 9-19 could not be used to determine the flow number due to the gradual transition from secondary creep to tertiary creep for most mixtures. The new criterion fro defining the flow number is based on the change in the rate of deformation the takes place during the test. It was arbitrarily selected that the cycle number at which the rate of deformation doubles compared to the lowest value of the rate of deformation to be the flow number for the mixture being tested. To achieve this, several steps are made to prepare the data to be analyzed. First the moving average of fifty points is calculated. Then, every average is divided by the lowest value of the total averages to normalize the data. At this stage the lowest point of the data is equal to the value of 1.00. Therefore, the point at which the rate of deformation is doubled compared to the lowest rate along the test, is equivalent to the value "2". This way the determination of the flow number is a simple step with minimum confusion. The graph in Figure 1 shows the flow number of a mixture after being analyzed using the mentioned procedures.
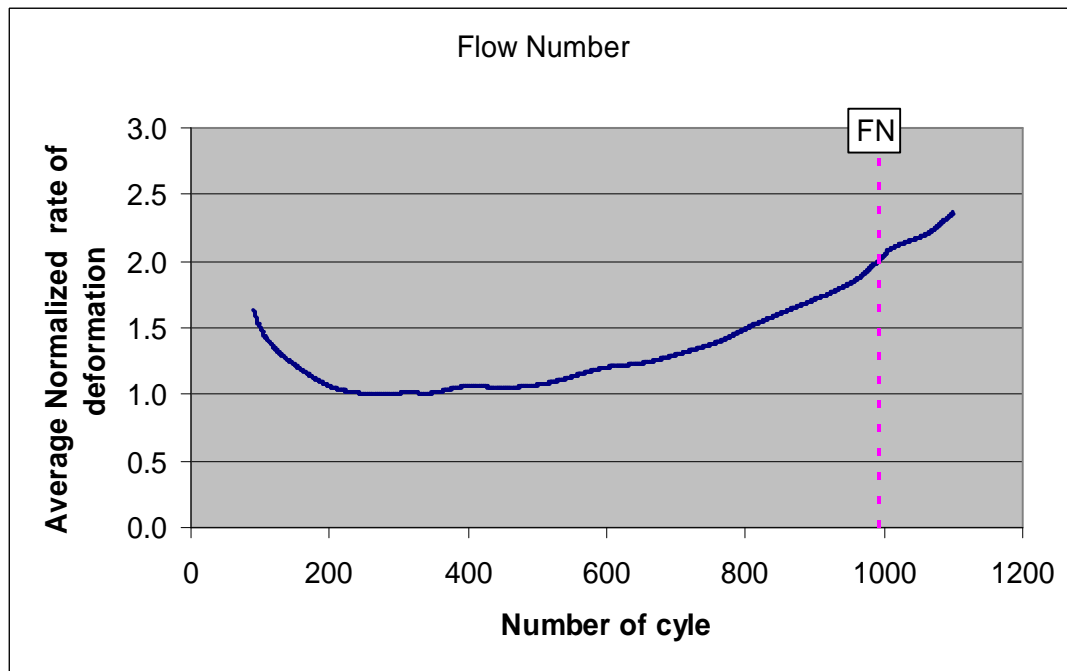
Figure 1: Determination of the flow number

A total of 36 samples were analyzed using this analysis method. The results were used to correlate with the traffic energy index (TEI) measured with the gyratory compactor. The results, shown in Figure 2, indicate that the expected trend where the higher the flow number the stronger the mixture, and thus the higher the traffic index. The following graph shows the flow number verses the traffic energy index (TEI).
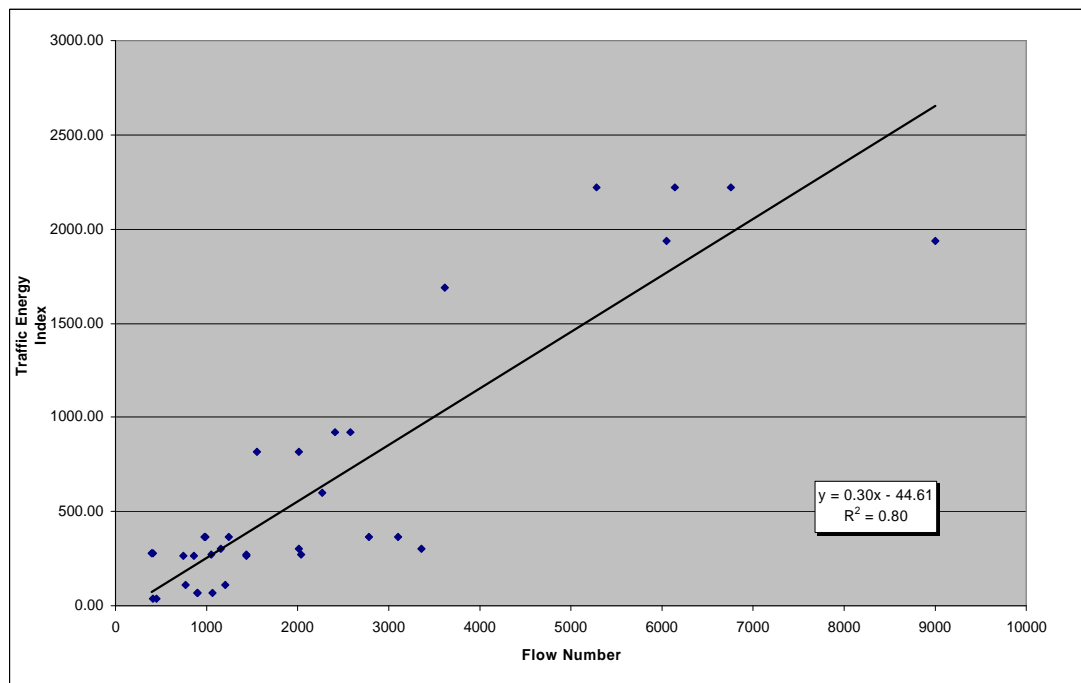

$$y = 0.30x - 44.61$$
$$R^2 = 0.80$$

Figure 2: Traffic energy index vs. Flow number using the current analysis Method

As shown in the previous graph (Figure2) there is a considerable correlation factor between the flow number and the TEI. However, more investigation is planned to verify this correlation. This investigation is going to tackle the determination of outliers.

Work Next Quarter:

The final draft of the report will be ready by the next quarter including the final analysis of the data. The analysis should include setting up some recommended limits regarding to the indices compared to the ESAL's.

Circumstances affecting progress/budget:

A no-cost time extension has been requested to allow time to deliver the final report and revise based on comments from report reviewers.

Gantt Chart:

PROJECT I.D.	STARTING DATE	COMPLETION DATE	MONTH	REPORT #		PERCENT OF			
PROJECT # WISDOT	**NOV 1, 2000**	**APR 30, 2002**	**December 2003**	1					

CONSULTANT FIRM NAME	% TIME ELAPSED	TOTAL PROJECT FUNDING	CONTRACT FUNDING						
UNIVERSITY OF WISCONSIN - MADISON	11.10%	100%	100%						

NAME OF STUDY
Using the Gyratory Compactor to Measure Mechanical Stability of Asphalt Mixtures

TASK *	YEAR (2000 / 2001 / 2002 / 2003 months N D J F M A M J J A S O N D...)	Project	Task Completed Last Report	Task Completed This Report	Project Completed
TASK 1 : LITERATURE REVIEW					
1.1 : Literature Review		21	100	0	21.00
1.2 : Review Meeting		4	100	0	4
TASK 2 : LABORATORY STUDY		37.5	100	0	37.5
TASK 3 : ESTABLISH MIXTURE DESIGN CRITERIA		17	40	60	17
TASK 4 : PLANS FOR FIELD STUDY		8	100	0	8
TASK 5: FINAL REPORT		12.5	40	40	10

SHOW PROGRESS BY USE OF A BAR CHART:	SCHEDULED				
	COMPLETED	100			97.50

Note: Gantt chart shown in State Fiscal Year Quarters